

## TITLE OF THE INVENTION

## PORTABLE ELECTRONIC DEVICE

## FIELD OF THE INVENTION

5 The present invention relates to portable electronic devices such as audio players and digital cameras of the portable type, and more particularly to portable electronic devices having two power supply systems from an external power source and that from an internal power 10 source.

## BACKGROUND OF THE INVENTION

Portable electronic devices such as audio players or digital cameras of the portable type conventionally have incorporated therein a dry battery or secondary battery 15 serving as the power source to realize the portability of the device. The devices are adapted to be connected to external power sources like commercial alternating power source, etc. for charging the secondary batteries.

In recent years, USB (Universal Serial Bus) has 20 attracted attention as a universal interface for connecting a plurality of peripheral devices in common to a host computer. The USB connector which is compliant

with the USB standard comprises a pair of data terminals D+ and D-, a power source terminal, and a grounding terminal, can provide high speed data communication using data terminals D+ and D-, and can be used for supplying power by way of the power source terminal. Accordingly, a method is studied that a portable electronic device is provided with a USB connector and the connector is, for example, connected to a personal computer to supply power to the device.

It is usual practice with the portable electronic device (compliant with the USB standard) having the USB connector to provide a main CPU for executing predetermined device operation processing for various operations of the device including reproduction of data, and a USB controller separate from the main CPU and adapted to execute predetermined data processing for carrying out data communication with the personal computer through the USB connector so as to ensure simplified processing.

When the USB compliant device, for example, downloads the compressed audio data from a personal computer to store the data on the memory card

incorporated therein, and thereafter to read the data stored in the memory card to reproduce the data, the audio data is read out from the memory card with the data processing executed at about 128 Kbps which is relatively 5 low speed. On the other hand, when the audio data is downloaded from the personal computer through the USB connector, the audio data which records sound for an hour is about 64 MB even if the data is compressed. If the transferring speed of 12 Mbps which is theoretical value 10 of the USB is drawn out to a maximum limit, it is necessary to take 40 seconds or more in transferring the data. Thus, since the data needs to be transferred as fast as possible, power source voltage of IC for executing the data transferring should be set as high as 15 possible.

The applicants have developed a portable electronic device wherein one chip IC conducts the control of write / read of the data to the memory card and the processing of data transfer (USB transfer) through a USB connector. 20 With the IC provided with the portable electronic device, while the supply of the power source voltage greater than 2.7 V makes it possible to read the data from the memory

card, the power source voltage greater than 3.0 V should be provided in order to realize high speed data transferring.

However, in the case where the USB connector is not connected to the personal computer to reproduce the data using internal power source including a dry battery, a secondary battery and the like, the internal power source is discharged with high voltage of greater than 3.0 V as described above. This entails the problem of shortening the life of the internal power source. Although the power source voltage is reduced to 2.7 V to prolong the life of the internal power source, the USB transferring speed is declined.

#### SUMMARY OF THE INVENTION

An object of the present invention is to provide a portable electronic device which is capable of high speed data communication, and is further adapted to prolong the life of the internal power source.

The portable electronic device of the invention comprises a power source terminal for connecting an external power source, an internal power source having lower voltage than the external power source, first

circuit means for executing first data processing, and second circuit means for executing second data processing which is lower in speed than the first data processing. The device is characterized by the construction wherein 5 power is supplied by the external power source through power source terminal when the first circuit means is operated, and power is supplied by the internal power source when the second circuit means is operated. The internal power source is formed by a dry battery or a 10 secondary battery.

With the portable electronic device of the invention, when the first circuit means is operated, the power source terminal is connected to the external power source to give the device high voltage of the power source 15 through the power source terminal. This realizes high speed data processing. On the other hand, when the second circuit means is operated, the device is given low voltage of the power source through the internal power source, so that the data processing speed becomes lower. 20 The speed is, though, sufficient to reproduce the audio data and the like, or rather setting of the lower voltage of the power source allows the internal power source to

prolong its life.

Stated more specifically, the portable electronic device is a USB compliant device which has a USB connector, compliant with the USB standard, and one of 5 terminals of the USB connector constructs the power source terminal. With the specific construction, the USB connector is connected to a personal computer to give the device high voltage of the power source from the personal computer realizing high-speed USB transferring with the 10 personal computer.

Further stated specifically, the first circuit means is provided by a data communication controller for executing predetermined data communication processing to conduct data communication with an external information 15 processing device, and the second circuit means is provided by a control circuit for executing device operation processing for the usual device operation connected to the data communication controller. With the specific construction, the data communication controller 20 is supplied with high voltage of the power source to realize high speed data communication processing. When the device is operated by the control circuit, low

voltage of the power source allows the internal power source to prolong its life.

With further specific construction, a first power supplying wire extends from the power supply terminal, 5 and a second power supplying wire extends from the internal power supply source. Reverse flow resist means is provided on the wires, respectively, each end of the wires is interconnected, and the interconnected point is connected to the first circuit means and the second 10 circuit means. With the specific construction, the external power source is connected to the power source terminal, so that the voltage impressed to the first wire is higher than the second wire. Accordingly, power is supplied from the external power source through the first 15 wire and the connected point to the first circuit means and the second circuit means. On the other hand, when the external power source is cut off from the power source terminal, the voltage impressed to the first wire falls to zero to supply power from the internal power source 20 through the second wire and the connected point to the first circuit means and the second circuit means.

As described above, the portable electronic device

of the invention adopts a method in which the two power supplying systems of a high voltage power supplying system from the external power source and a low voltage power supplying system from the internal power source are 5 changed over according to the content of the data processing. Thus, the internal power source life can be prolonged while the device makes high speed data communication possible.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10 FIG. 1 is a block diagram showing the construction of a portable audio player embodying the invention.

#### DETAILED DESCRIPTION OF EMBODIMENTS

A portable audio player embodying the present invention will be described below in detail with 15 reference to FIG. 1. A portable audio player 1 embodying the invention, as shown in the drawing, comprises a USB connector 4 connectable to a USB connector 5 of a host personal computer 2 through a USB cable. The USB connector 4 has a pair of data terminals D+ and D-, a power source terminal V<sub>DD</sub>, and a grounding terminal GND. 20

The audio player 1 is provided with a USB controller 6 to execute predetermined data communication

processing for performing data communication with the personal computer 2 through the connector 4, a main CPU 7 to execute predetermined device operation processing for various operations of the device including reproduction 5 of data, a memory 9 constructed by a Multi Media Card and the like, an internal power source 3 constructed by a secondary or a dry battery. The connection of the connector 4 to the personal computer 2 applies the power source voltage of 5 V to the power source terminal  $V_{DD}$  of 10 the connector 4.

The pair of data terminals D+ and D- of the USB connector 4 are connected to a pair of data terminals D+ and D- provided on the USB controller 6. The grounding terminal GND is grounded.

15 A first power supplying wire 14 extends from the power source terminal  $V_{DD}$  of the connector 4, and a first voltage regulator 10 and a first diode 12 are provided on the wire 14. This adjusts the power source voltage of 5 V obtained from the terminal  $V_{DD}$  of the connector 4 to 3.3 V. 20 A second power supplying wire 15 extends from the internal power source 3, and a second voltage regulator 11 and a second diode 13 are provided on the wire 15.

This adjusts the power source voltage of 3 V obtained from the internal power source 3 to 2.8 V.

Each end of the first wire 14 and second wire 15 is interconnected. A third power supplying wire 16 extending 5 from the interconnected point 8 is connected to the USB controller 6, the main CPU 7, and the memory 9 to supply power.

When the audio player 1 downloads audio data from the personal computer 2 with the connector 4 connected to 10 the computer 2, the computer 2 applies the power source voltage of 5 V to the terminal  $V_{DD}$  of the connector 4, so that the voltage (about 3.3 V) obtained at an output end of the first diode 12 of the first wire 14 is greater than the voltage (about 2.8 V) obtained at an output end 15 of the second diode 12 of the second wire 15.

Consequently, the power from the terminal  $V_{DD}$  of the connector 4 is supplied to the controller 6, the CPU 7, and the memory 9 through the first wire 14, the interconnected point 8, and the third wire 16.

20 As a result, USB control function of the USB controller 6 is activated, causing the controller 6 to download the audio data from the personal computer 2,

activating memory control function of the controller 6, storing the downloaded data to the memory 9.

When the computer 2 is thereafter cut off from the connector 4, reading out the audio data stored in the 5 memory 9, to reproduce sound, the cut off from the computer 2 reduces the voltage applied to the first wire 14 to zero. Accordingly, the power of the internal power source 3 is supplied to the controller 6, the CPU 7, and the memory 9 through the second wire 15, the 10 interconnected point 8, and the third wire 16.

Thus, while the memory control function of the controller 6 is activated to read out the audio data stored in the memory 9, reproduction control function of the CPU 7 is activated to reproduce the read data as 15 sound.

As described above, in the case where the audio player 1 embodying the invention downloads or uploads the audio data with the connector 4 connected to the computer 2, the high power source voltage supplied by the computer 20 2 realizes high speed data communication. When the audio data is reproduced with the connector 4 cut off from the computer 2, power is supplied by the low power source

voltage from the internal power source, so that the life of the dry or secondary battery can be prolonged providing the internal power source 3.

The present invention is not limited to the foregoing embodiment in construction but can be modified variously by one skilled in the art without departing from the spirit of the invention as set forth in the appended claims. For example, the invention can be practiced not only for digital audio players but also for digital video devices such as digital cameras, etc.